

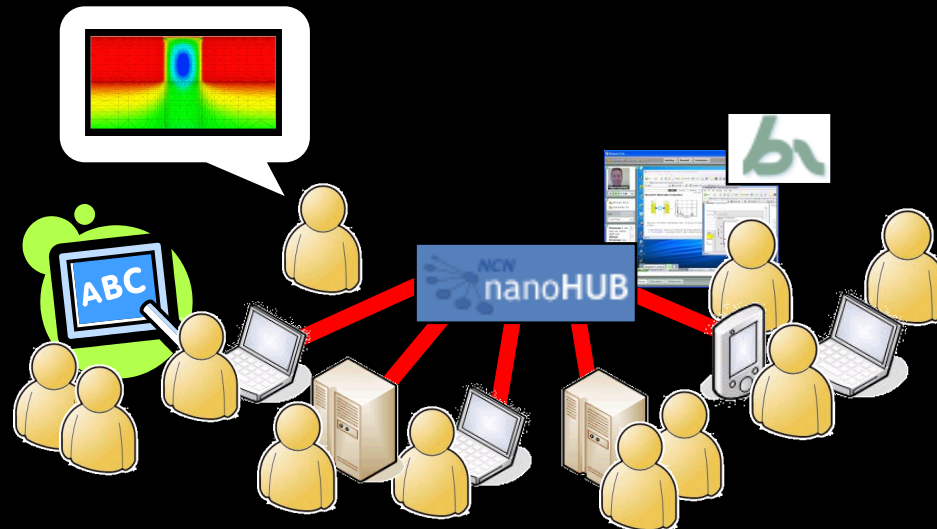
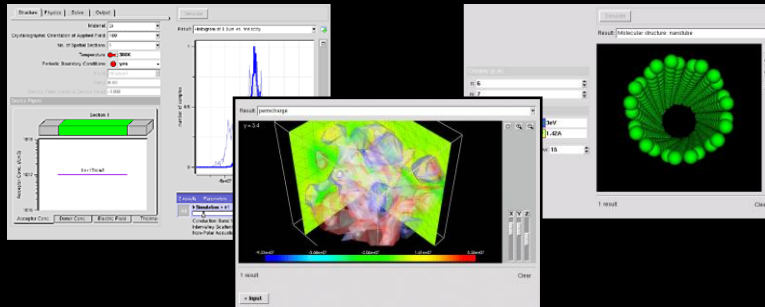
# **nanoHUB.org: Cyberinfrastructure for Nanotechnology Research and Education**

Michael McLennan  
Network for Computational Nanotechnology  
Purdue University

# What is nanoHUB?

*Online simulation...*

*...and more!*



# Demo



[Demo >>](#)

# Who's using nanoHUB?

5.5 million hits last month

85,184 users last 12 months

374,527 simulation jobs last 12 months

51 of the Top 50 Engineering Schools

14% of all .edu domains

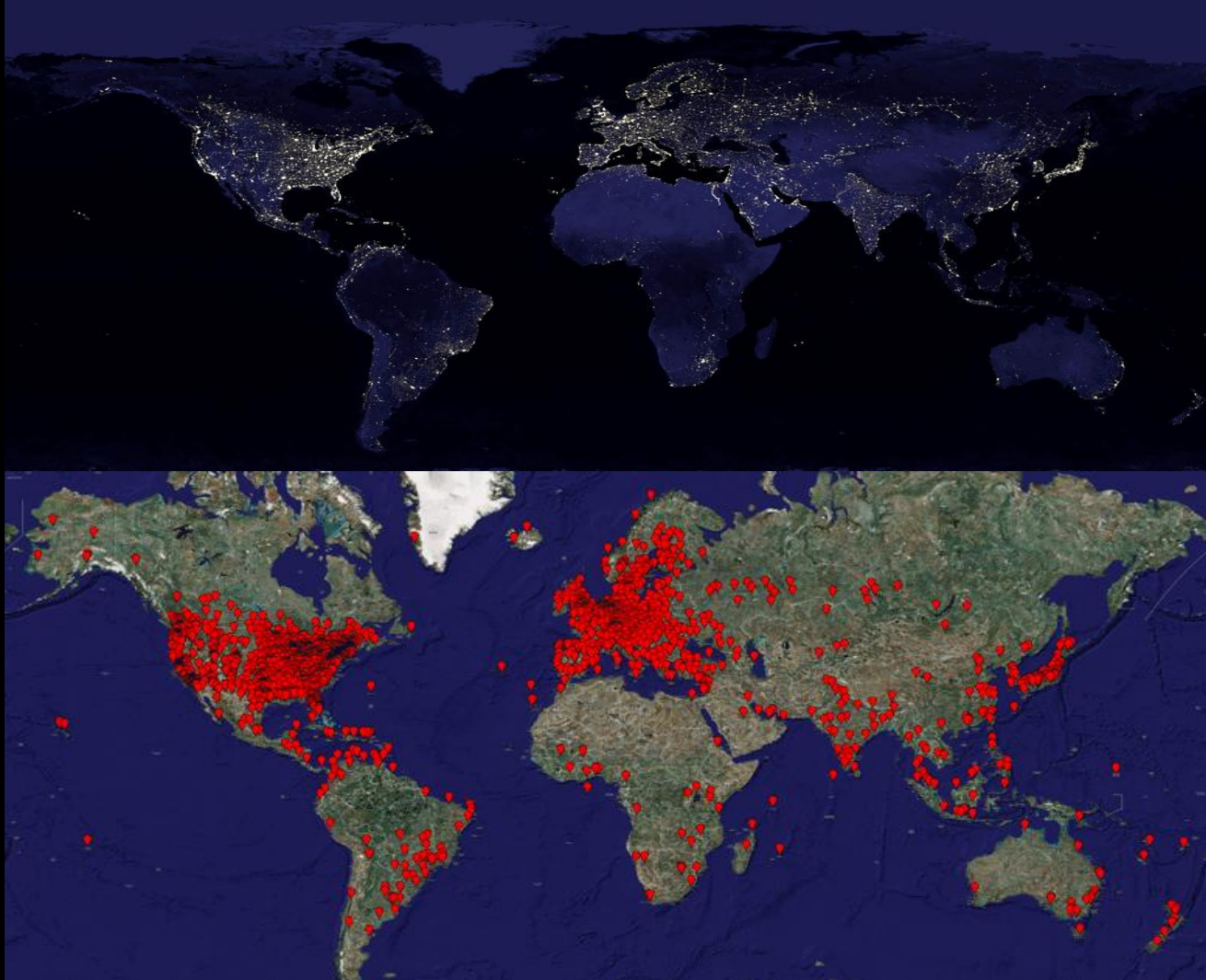


40% in US

60% from 172 countries

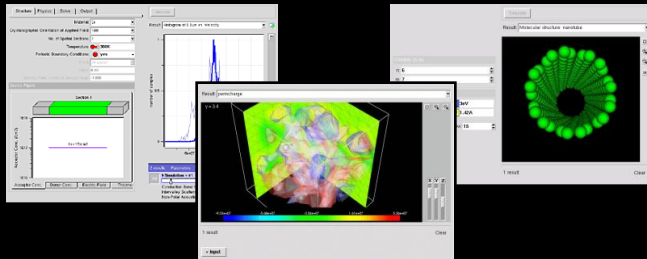


# Who's using nanoHUB?

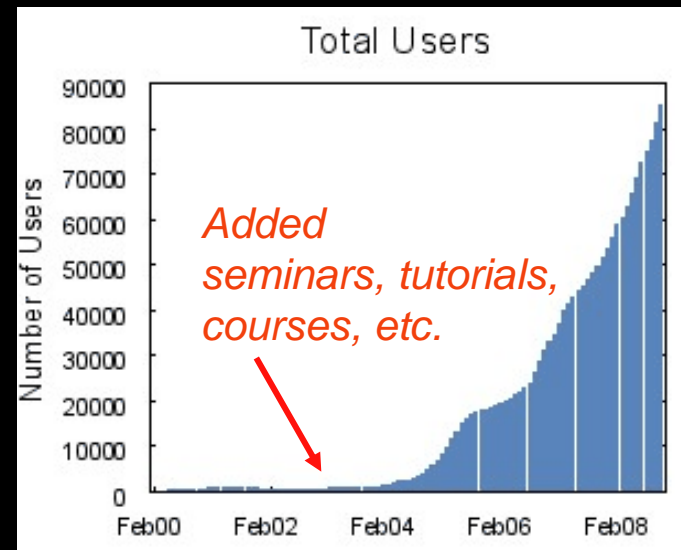
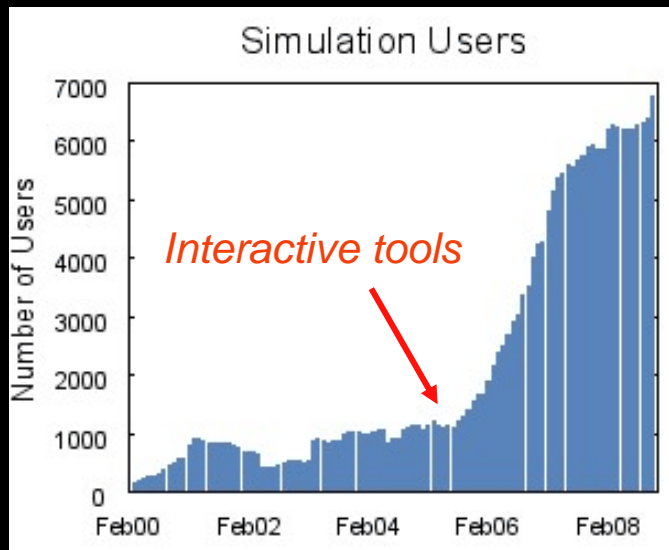


# Strong growth

*Online simulation...*



*...and more!*



# Google Scholar

## finds 434 citations to nanoHUB

nanoHUB - Google Scholar - Windows Internet Explorer

http://scholar.google.com/scholar?q=nanoHUB&hl=en&lr=

Google Scholar BETA

nanoHUB

Search

Advanced Scholar Search  
Scholar Preferences  
Scholar Help

Scholar All articles - Recent articles

Results 1 - 10 of about 434 for nanoHUB. (0.09 seconds)

[PDF] ► **NEMO 3-D and nanoHUB: Bridging Research and Education**  
G Klimeck, M McLennan, M Mannino, M Korkusinski, C ... - Nanotechnology  
Page 1. NEMO 3-D and nanoHUB: ... Keywords-Quantum Dot, electron transport, tight binding, tool, community computing. I. NCN and nanoHUB  
[Cited by 2](#) - [Related articles](#) - [View as HTML](#) - [Web Search](#) - [All 2 versions](#)

[CITATION] Discovery Park's **nanoHUB** site draws record student interest  
P Fiorini - Purdue University News  
[Cited by 2](#) - [Related articles](#) - [Web Search](#)

[CITATION] Schred 2.1 tutorial, 2003, downloaded from [http://www. nanoHUB. org/index. php? option= ...](http://www.nanoHUB.org/index.php?option=...)  
S Hassan - Schred available at [http://www. nanoHUB. org/ ...](http://www.nanoHUB.org/)  
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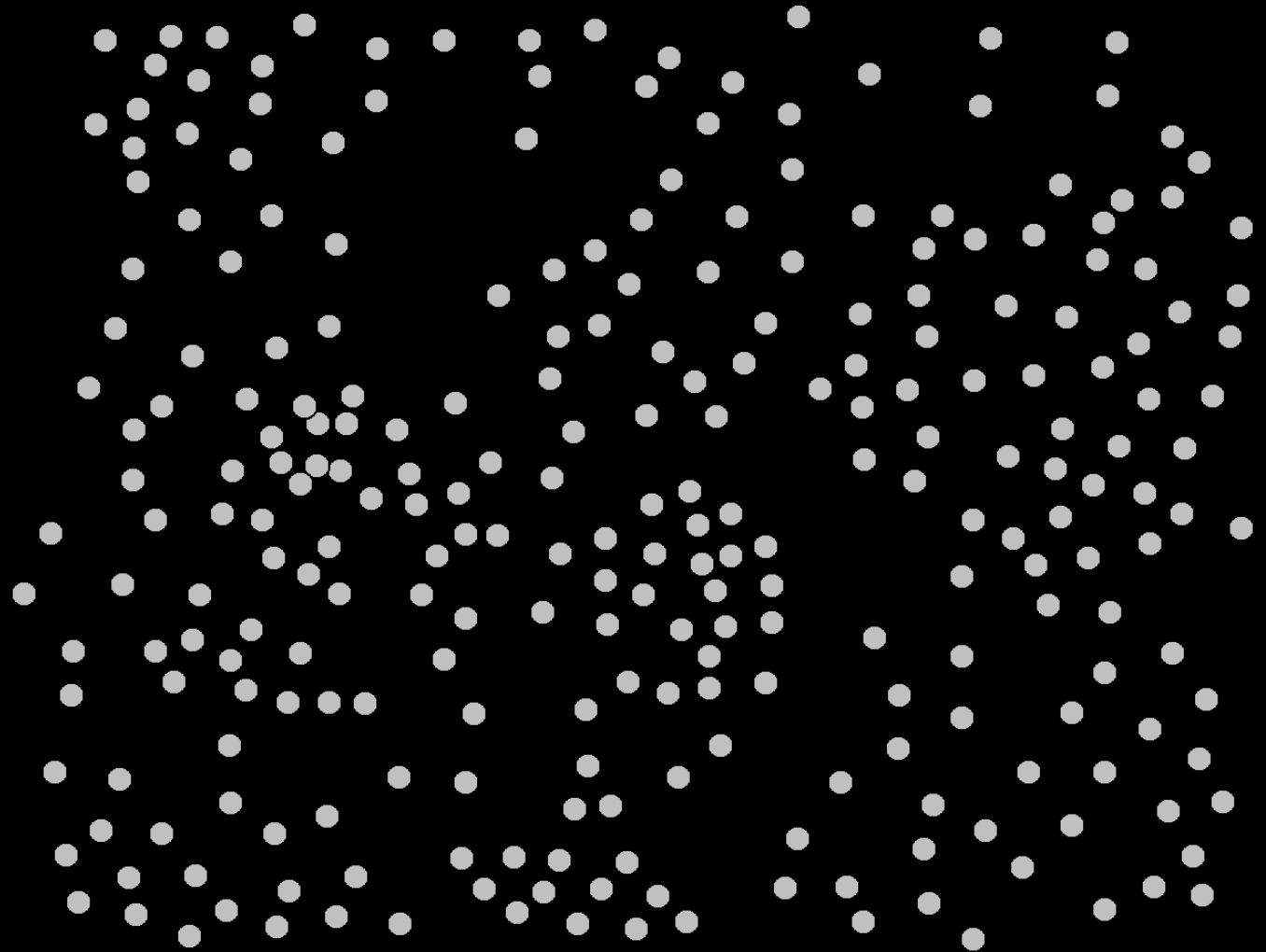
[CITATION] **nanoHUB. org**: Future Cyberinfrastructure Serving a Community of 60,000 Today  
GB Adams III, G Klimeck, M Lundstrom, M McLennan  
[Cited by 1](#) - [Web Search](#)

[CITATION] The **nanoHUB**: Community and Collaboration  
C Windham - EDUCAUSE Review, 2007  
[Cited by 1](#) - [Web Search](#)

**Autonomic adaptation of virtual distributed environments in a multi-domain infrastructure**  
D Xu, P Ruth, J Rhee, R Kennel, S Goasguen, P By, ... - Proc. of IEEE Intl Symp. on High-Performance Distributed ... - [nanoHUB.org](http://www.nanoHUB.org)  
Page 1. **nanoHUB.org** 1 online simulations and more Network for Computational Nanotechnology ... Purdue University Page 2. **nanoHUB.org** 2 online simulations and more ...

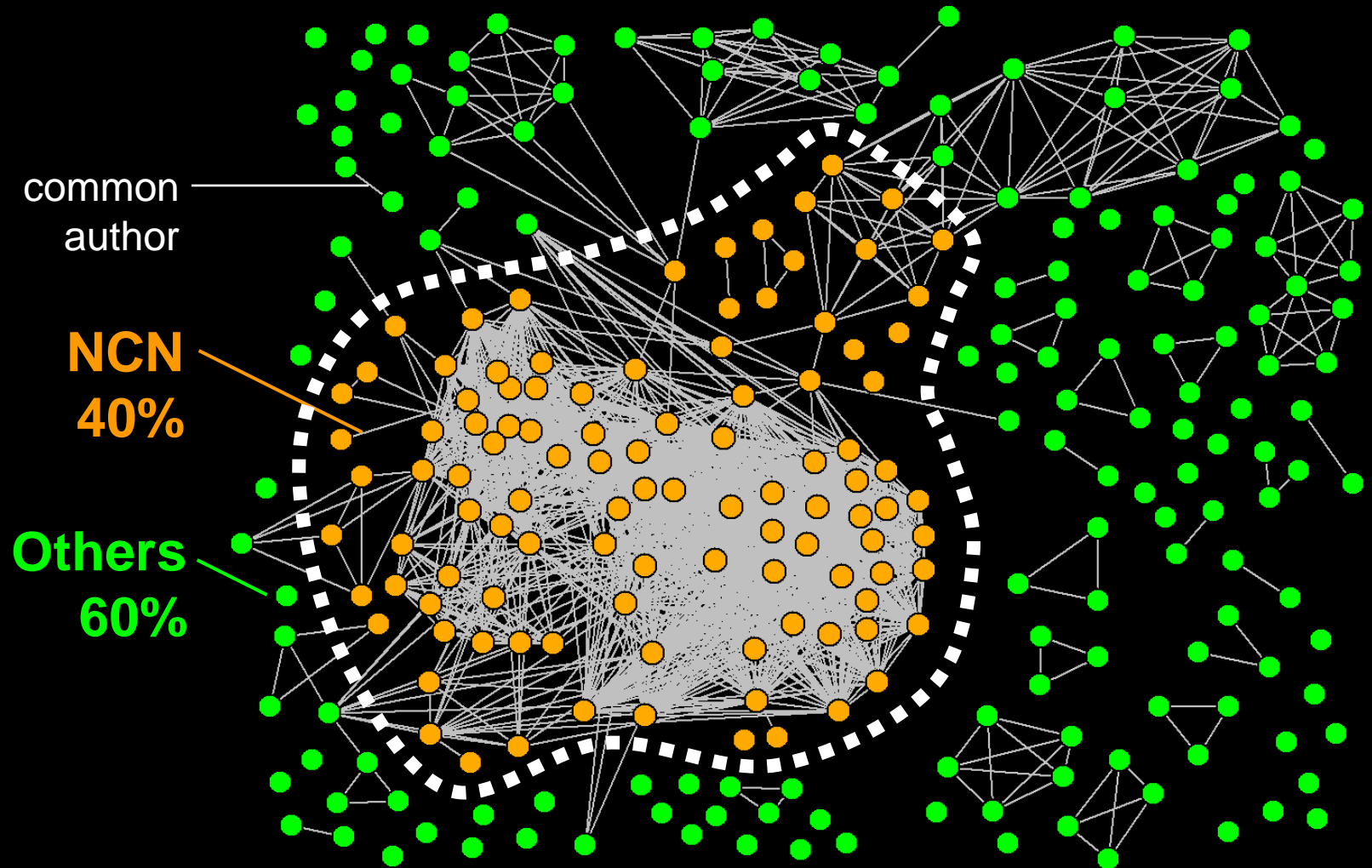
Internet 100%

# 265 Citations

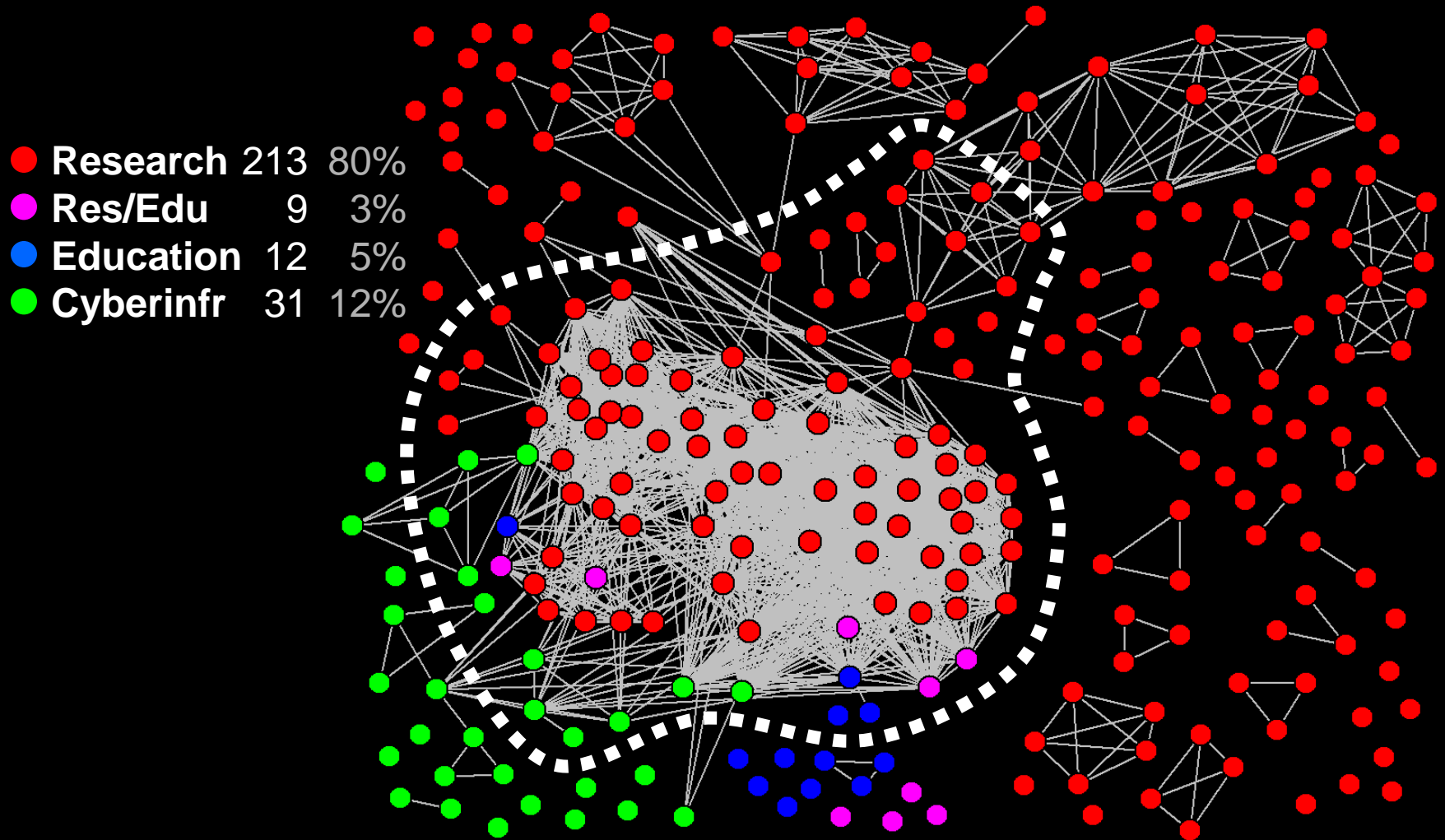




# 265 Citations... Who?

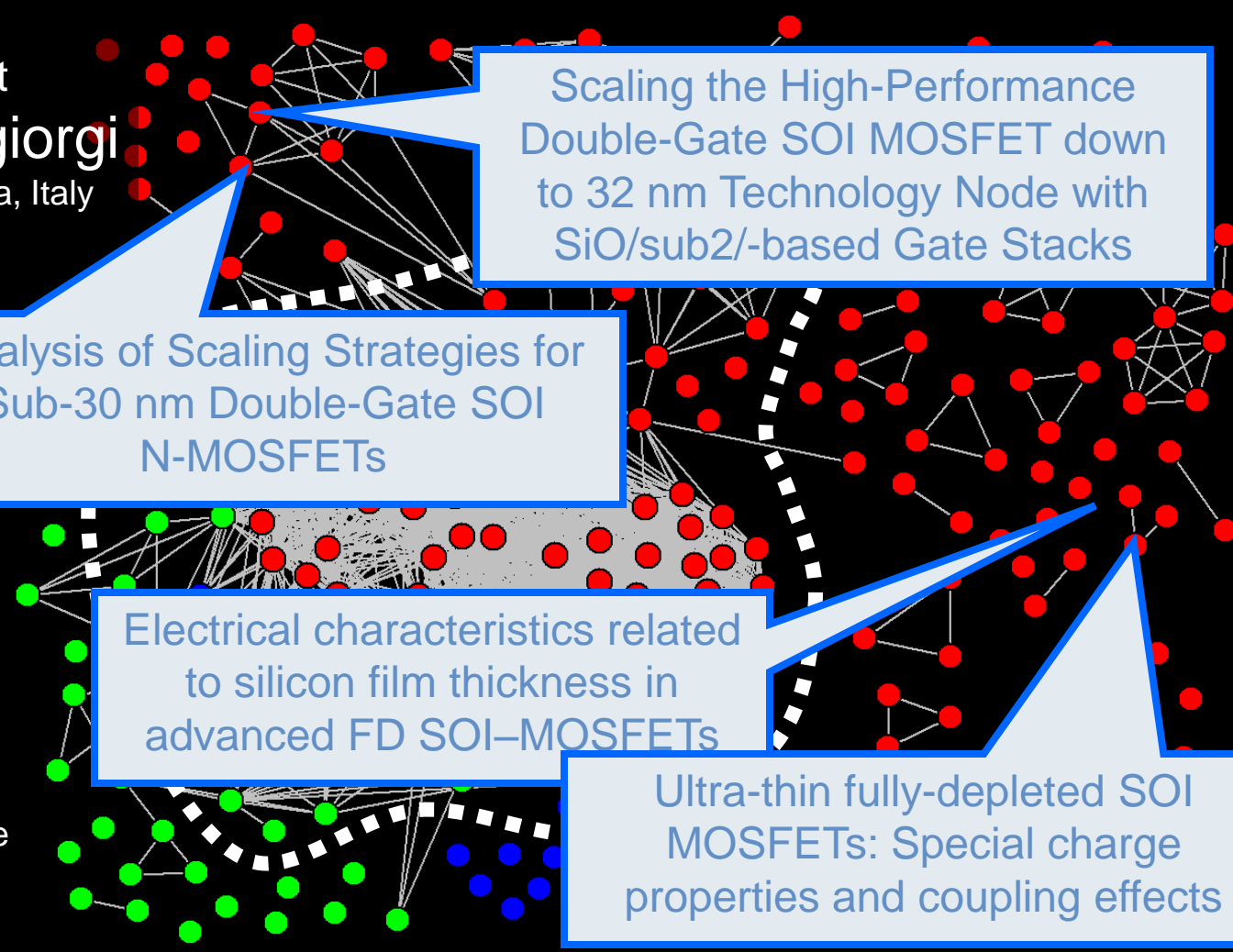


# 265 Citations... Cited for what?



# 265 Citations... Examples

Device Physicist  
**Enrico Sangiorgi**  
University of Bologna, Italy



Scaling the High-Performance Double-Gate SOI MOSFET down to 32 nm Technology Node with SiO<sub>2</sub>-based Gate Stacks

Analysis of Scaling Strategies for Sub-30 nm Double-Gate SOI N-MOSFETs

Electrical characteristics related to silicon film thickness in advanced FD SOI-MOSFETs

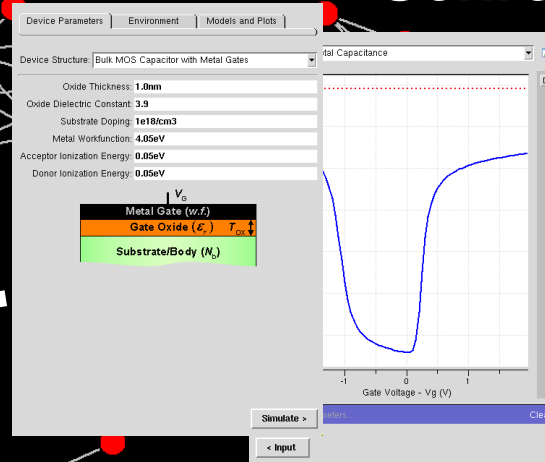
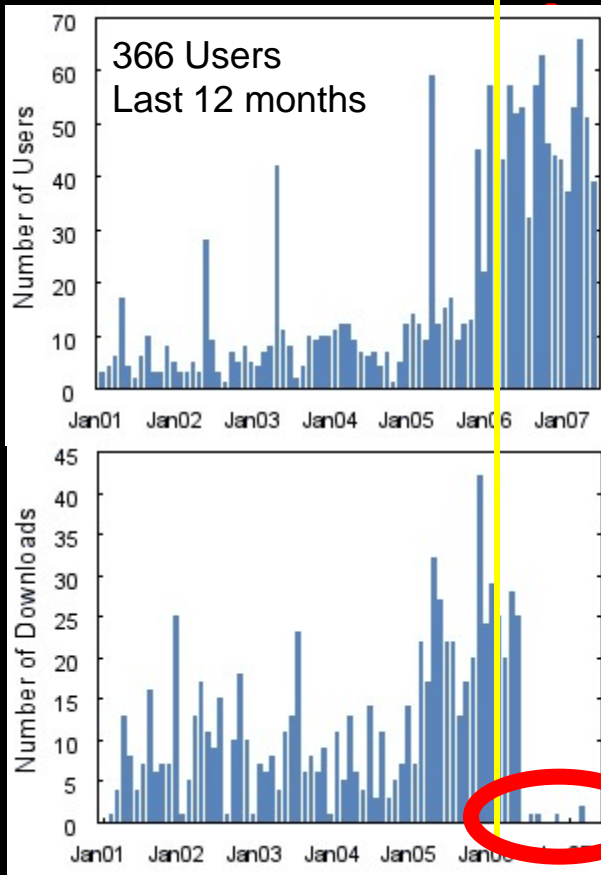
Ultra-thin fully-depleted SOI MOSFETs: Special charge properties and coupling effects

Experimentalist  
**Akiko Ohata**  
IMEP Minatéc, France

# Downloading is Dead

Rappture version Feb 06

Schred: 80 Citations



- Same behavior across all similar converted tools
- User's don't have to download/install software



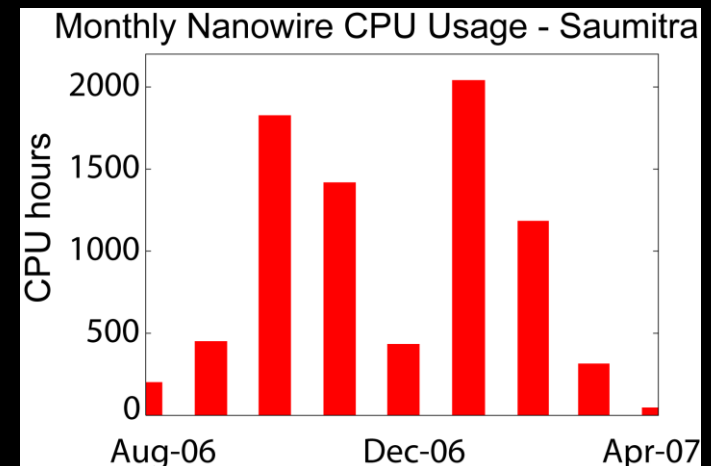
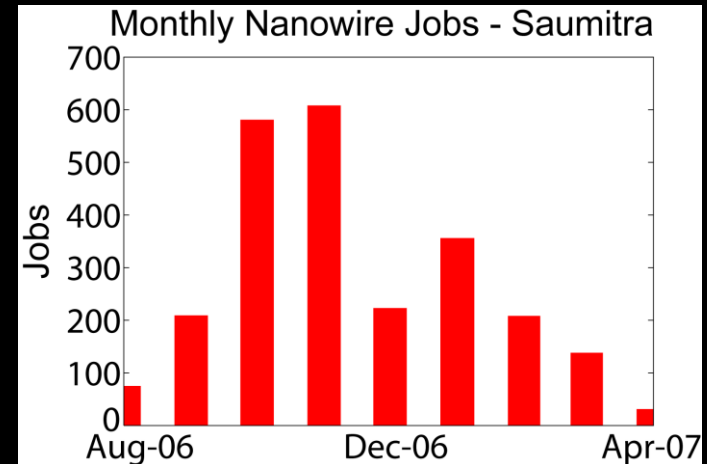
# Saumitra Mehrotra

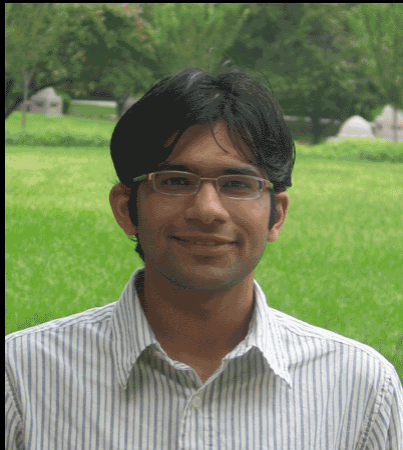
Univ. of Cincinnati

August 2006 - April 2007:

**26 tools / 3,327 simulations**

- 47 simulations: bandstructure lab
- 240 simulations: FETtoy
- 2,855 simulations: nanowire
- 8,242 nanowire CPU hours
- “and more” content  
134 items, 52 hours
- 96 support tickets  
69 entered manually,  
27 filed automatically by application





IEEE Workshop on Microelectronics and  
Electron Devices (WMED), April 20 2007

Process Variation Study for Silicon

Simulation Tool

SiNW FET Vs FinFET – Gate Length Variation

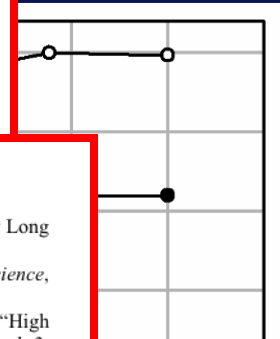
## Process Variation Study for Silicon Nanowire Transistors

performance in circuits and superior reproducibility for the  
SiNW FETs.

Fig. 4 shows the variation in the threshold voltage with  
change in the gate dielectric thickness. Again, the SiNW FET  
shows a smaller variation (1.2 mV/A) compared with the  
FinFET's 5 mV/A. Also of interest is the sensitivity of the  
devices to the gate length. Shown in Fig. 5 is the threshold

### REFERENCES

- [1] W.S. Shi et al., "Synthesis of Large Areas of Highly Oriented, Very Long  
Silicon Nanowires," *Adv. Mater.* 12, 1343, 2000.
- [2] D. Ma et al., "Small-Diameter Silicon Nanowire Surfaces," *Science*,  
299, p. 1874, 2003.
- [3] Y. Cui, Z. Zhong, D. Wang, W. U. Wang, and C. M. Lieber, "High  
Performance Silicon Nanowire Field-Effect Transistors," *Nature*, vol. 421,  
p. 49, 2002.



- [7] J. Wang, E. Polizzi, M. Lundstrom, "A three-dimensional quantum  
simulation of silicon nanowire transistors with the effective-mass  
approximation," *Journal of Applied Physics* **96**(4), pp. 2192-2203, 2004.
- [8] Simulations were performed on <http://nanohub.org>
- [9] J. Wang, E. Polizzi, and M. Lundstrom, "A computational study of  
ballistic silicon nanowire transistors," in *IEDM Tech. Dig.*, Dec. 8–10,  
2003, pp. 695–698.



nanoHUB - Simulation, Education, and Community for Nanotechnology - Windows Internet Explorer

http://www.nanohub.org/

Google

nanoHUB - Simulation, Education, and Community for ...

Login Register 177 guests, 13 members online - 5630206 hits last month

an NCN project

online simulation and more

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Tools for NEMS and Nanofluidics
- Nano-Bio Devices  
Tools for nano-bio devices
- More  
Browse all available tools

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- Seminars / Workshops  
Cutting edge research
- Collaborate  
Work with your colleagues
- Web Meetings  
Right in your browser
- User Groups  
Share with your colleagues

Teach & Learn

- Tool Powered Curricula  
Tools and Assignments for
- Nano 101 / Nano 501  
Introductory tutorials
- Nanocurriculum  
Curriculum on Nanotechnology
- More Teaching Materials  
Graduate, Undergrad

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### Contribute Content

Upload your own materials



### Give us Feedback

Success story? Suggestions?



### Take a Poll

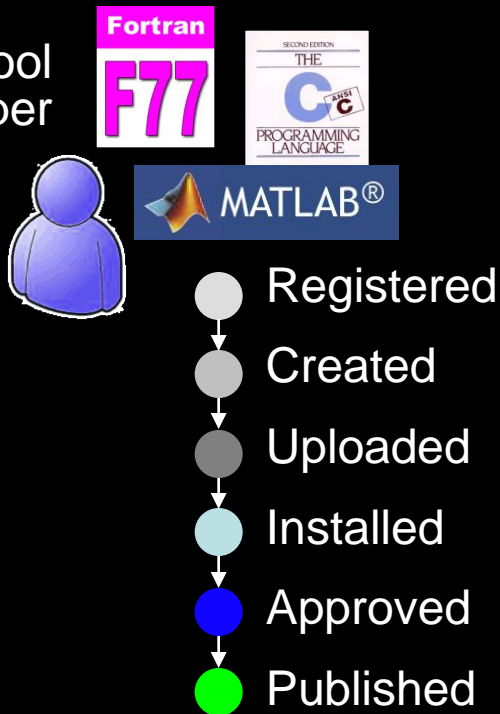
I wish nanoHUB had more...



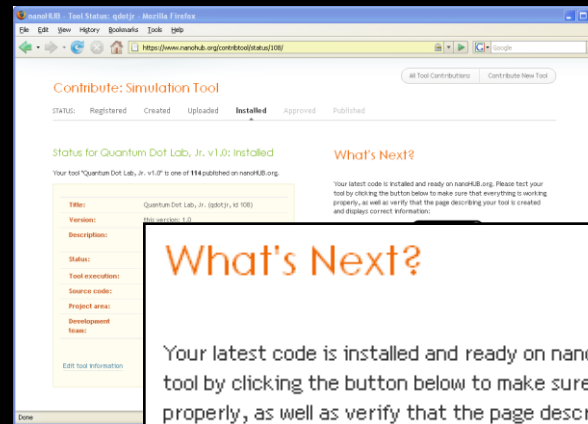
### Donations

Contribute your financial support

Tool Developer



End User



Web-based  
Publishing  
System

## What's Next?

Your latest code is installed and ready on nanoHUB.org. Please test your tool by clicking the button below to make sure that everything is working properly, as well as verify that the page describing your tool is created and displays correct information:

➡ Test your application: **Launch tool**

➡ [Review the page describing your tool](#)

## We're waiting for You

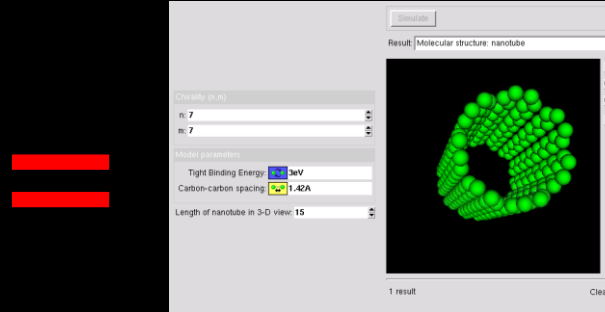
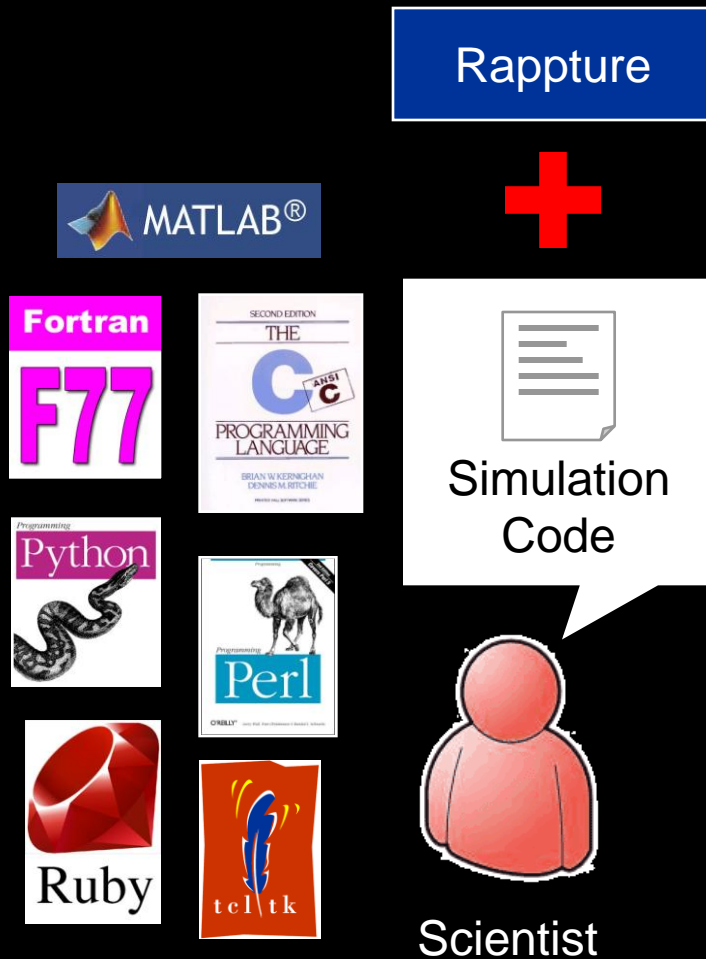
Once you tested your tool and verified that it is working properly, click here to let us know:

➡ [My tool is working properly. I approve it.](#)

Need to make changes? Once you've checked in your latest fixes, click here to let us know:

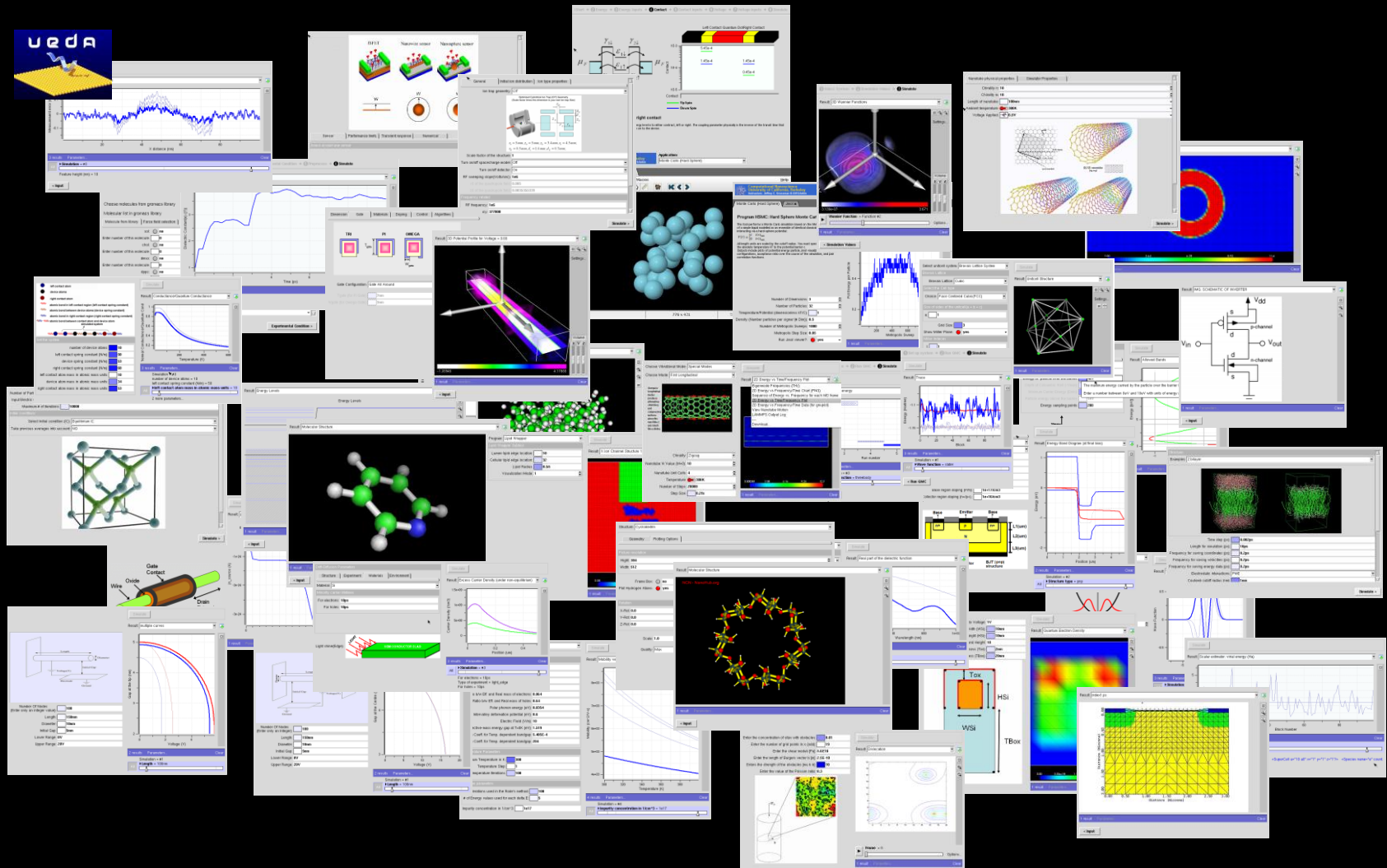
➡ [I've fixed my code. Please install the latest updates.](#)

# Rappture Toolkit



- Created by NCN in Nov 2004
- Create standard desktop apps
- Works with your favorite programming language
- Open Source
- Online at <http://rappture.org>

and 90 more coming soon



# A New Way of Publishing

The collage features a violin at the top right, symbolizing art and science. Below it are server racks and logos for TeraGrid and Open Science Grid, representing high-performance computing and open access. A speech bubble on the left contains a heatmap image. In the center, a web browser window displays 'A Gentle Introduction to Nanotechnology and Nanoscience' with a scale bar showing various nanoscale objects like Bacteriophage, Flu Virus, and C<sub>60</sub> Molecules. Overlaid on the browser is a software interface for device simulation, showing parameters like Material, Temperature, and Periodic Boundary Conditions, along with a graph of current density versus voltage.

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